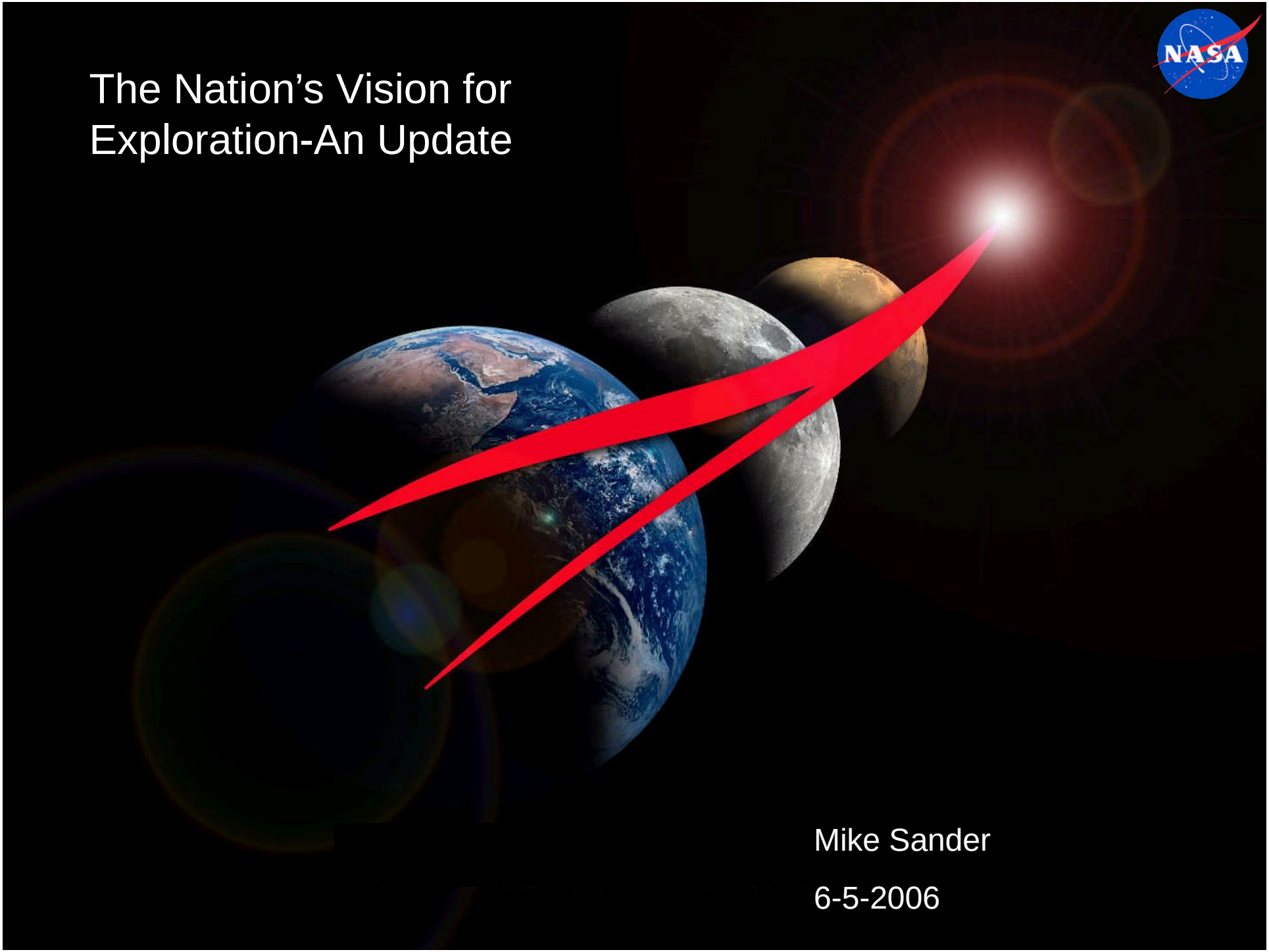
The Nation's Vision for Exploration-An Update



Mike Sander

6-5-2006

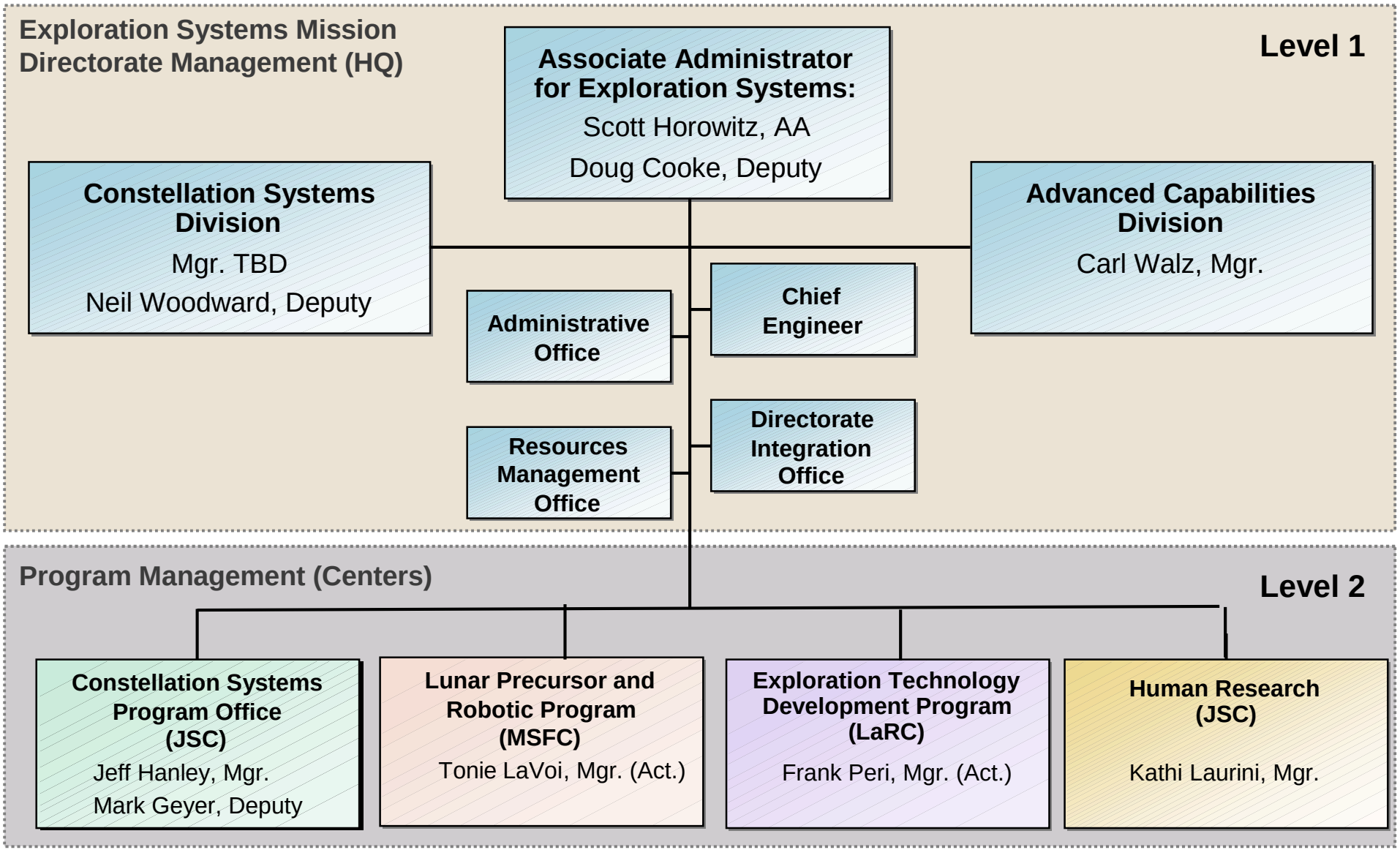
Outline

- Background
- Getting to the Moon
- Mars

What is ESMD?

- **Exploration Systems Mission Directorate at NASA HQ**
- **Sponsors the non-recurring work associated with the Nation's Vision**
- **Works through four level 2 program offices:**
  - Johnson Space Center – Constellation Program (Cx) Office
  - Marshall Space Flight Center-Lunar Precursor and Robotic Program
  - Langley Research Center – Exploration Technology Development Program (ETDP) Office
  - Johnson Space Center – Human Research

Exploration Systems Headquarters Organization



What is Constellation?

- **Name applies to the program activity which builds the flight systems for the Nation's Vision**
  - Crew Exploration Vehicle (CEV) + Crew Launch Vehicle (CLV)
    - Provide US access to Space Station
  - Cargo Launch Vehicle (CaLV) + Earth Departure Stage (EDS) + Lunar Surface Access Module (LSAM) + new space suits
    - Together with CEV and CLV provide capability to return humans to the Moon's surface

Background
Current State

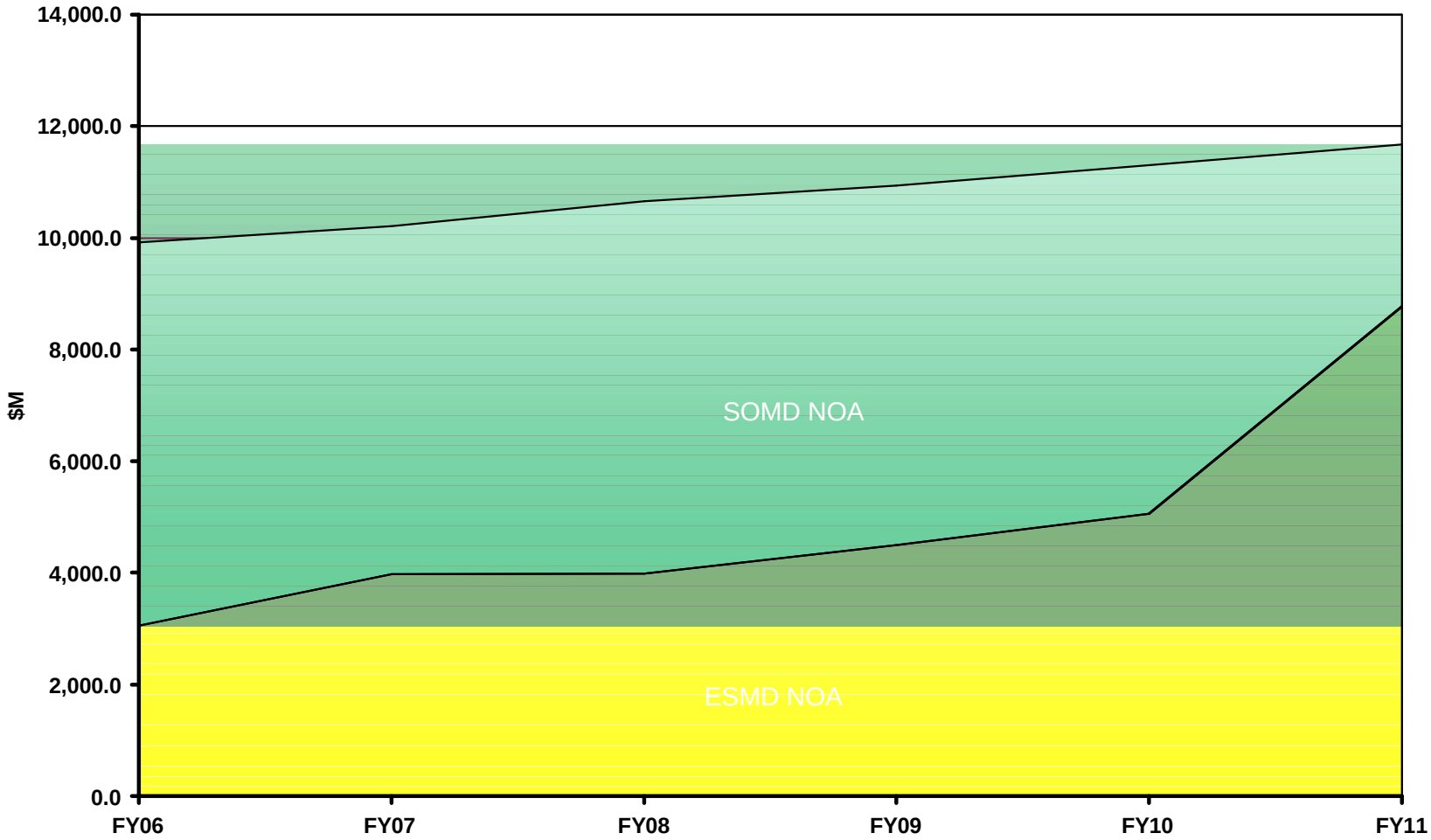
- **Top level ESMD Program roles are stabilizing**
  - JSC Level 2 office key staffing well underway
  - MSFC Lunar Precursor and Robotic Program office announced (replaces ARC RLEP office)
  - LaRC technology program office leadership assignments pending
- **Program content and definition are beginning to move to next levels of detail**
- **Budget constraints continue to be the dominant issue**
- **ESMD program priorities (ISS support, Moon, then Mars)**

Background

Recent Key Program Events, continued

- ESAS architecture tuned
  - 5 segment SRM
  - 5M diameter CEV
  - Delayed methane/oxygen propulsion, move to J-2x, RS-68 engines
  - 10 meter diameter CaLV core
- Smart Buyer team for CEV-support module-launch escape system
- Continuing budget development (Bottoms Up Review and POP preparation)

Human Space Flight NOA



Background

Recent Key Program Events

- Technology program cut, restructured
  - Very Constellation focused
- CEV industry strategy modified
  - CEV RFP and delta released, entering proposal evaluation phase

- CLV design spinning up

Outline

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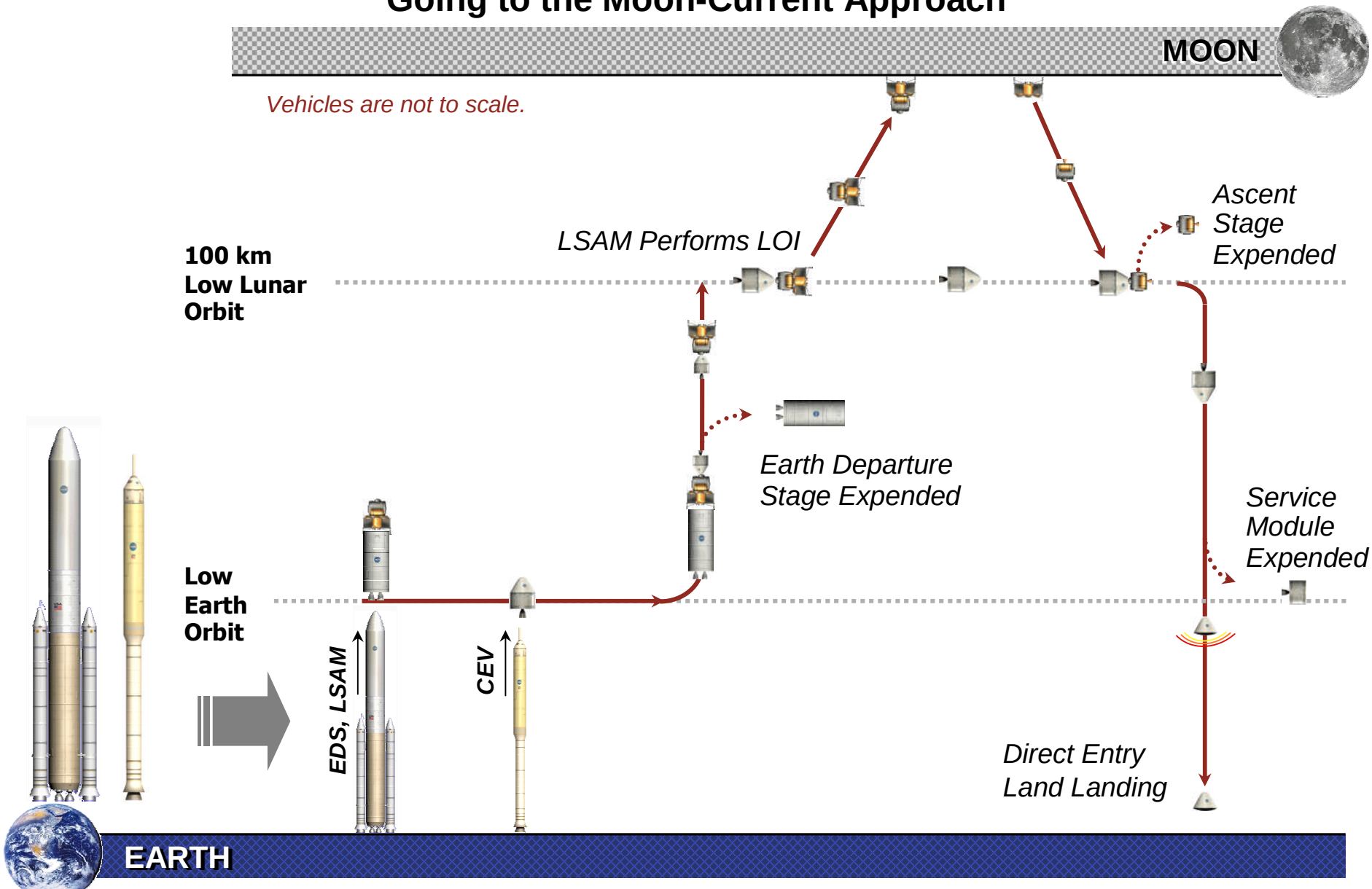
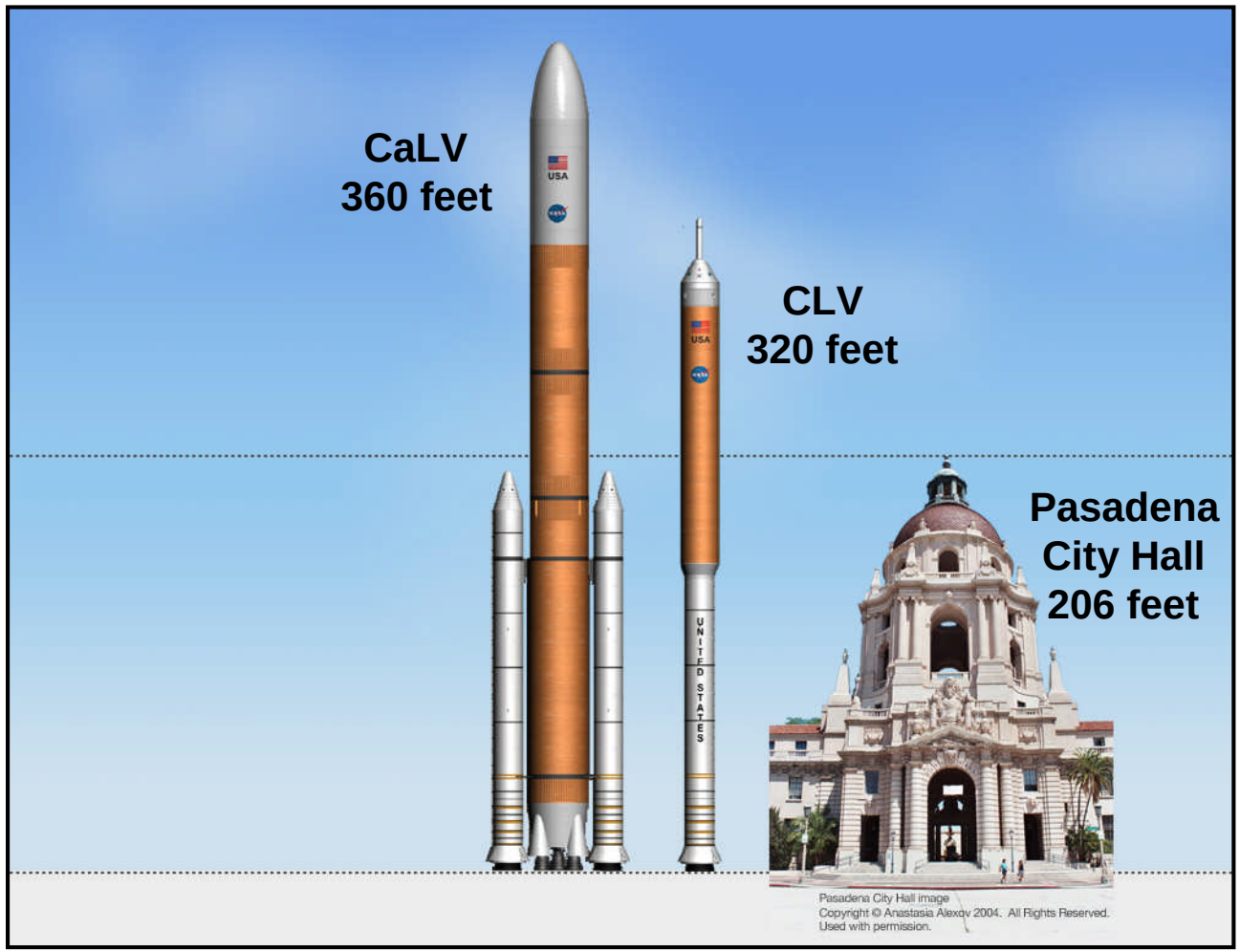
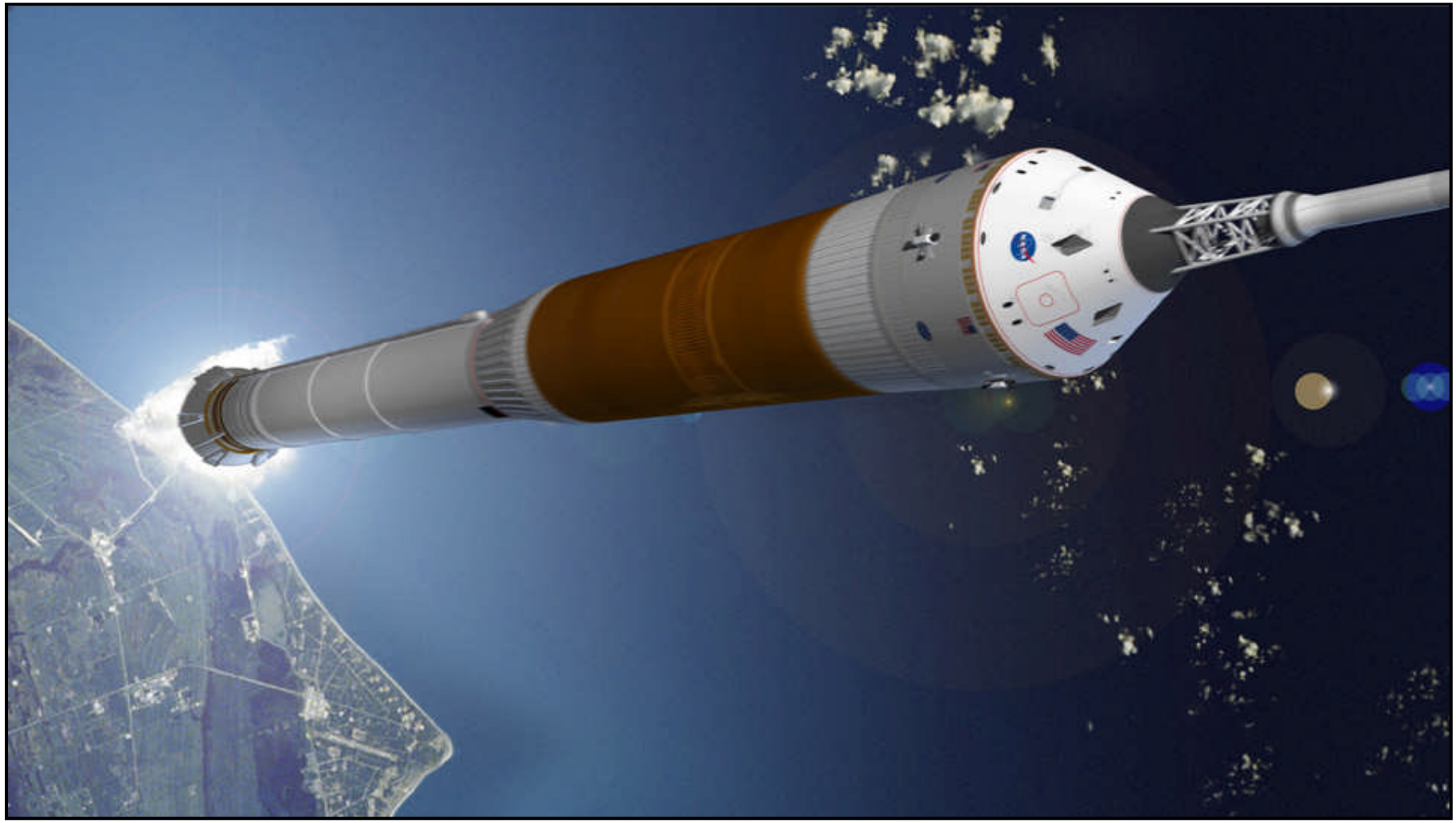
Going to the Moon-Current Approach



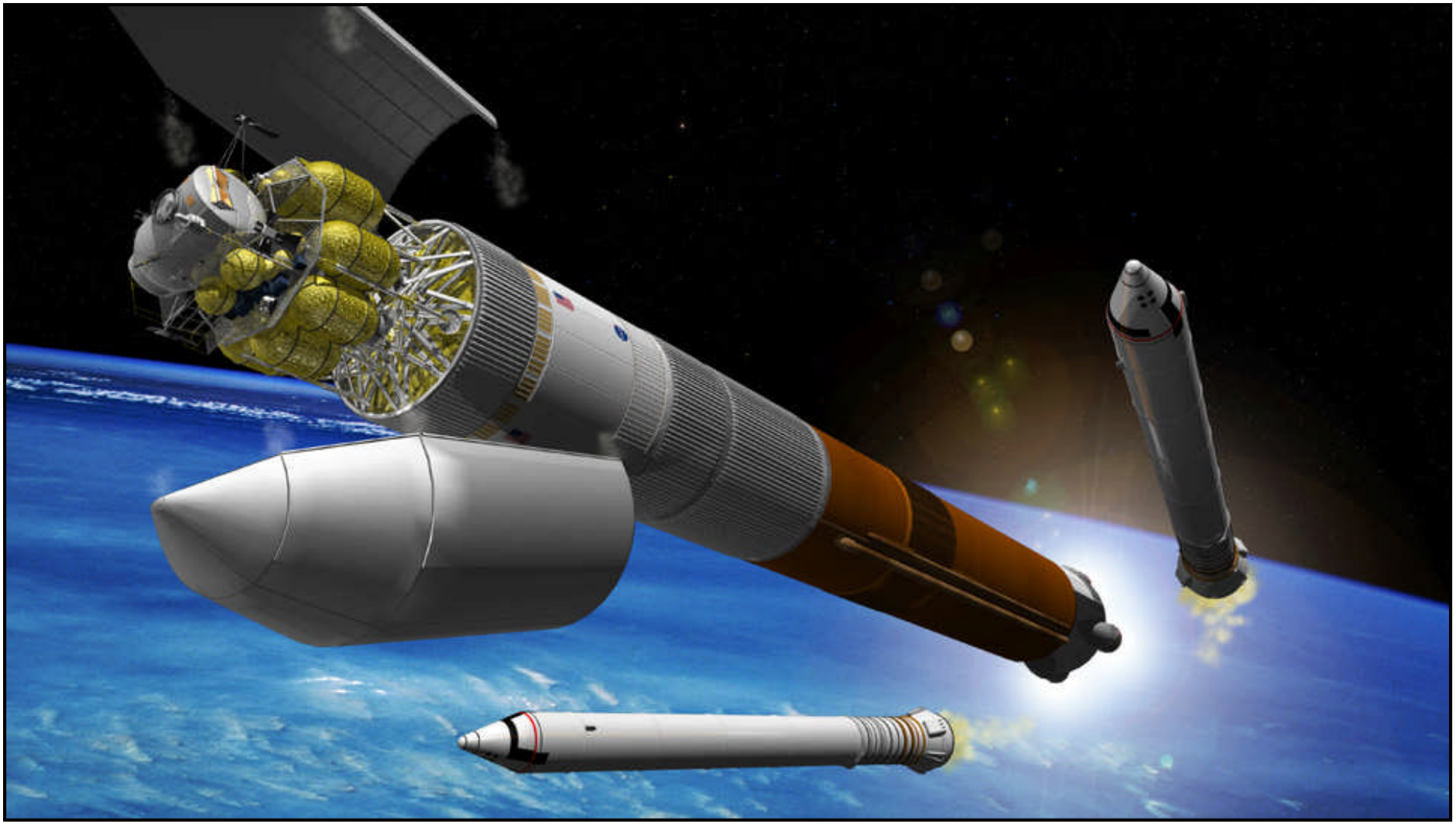
Constellation Systems – Cargo Launch Vehicle (CaLV) and Crew Launch Vehicle (CLV)



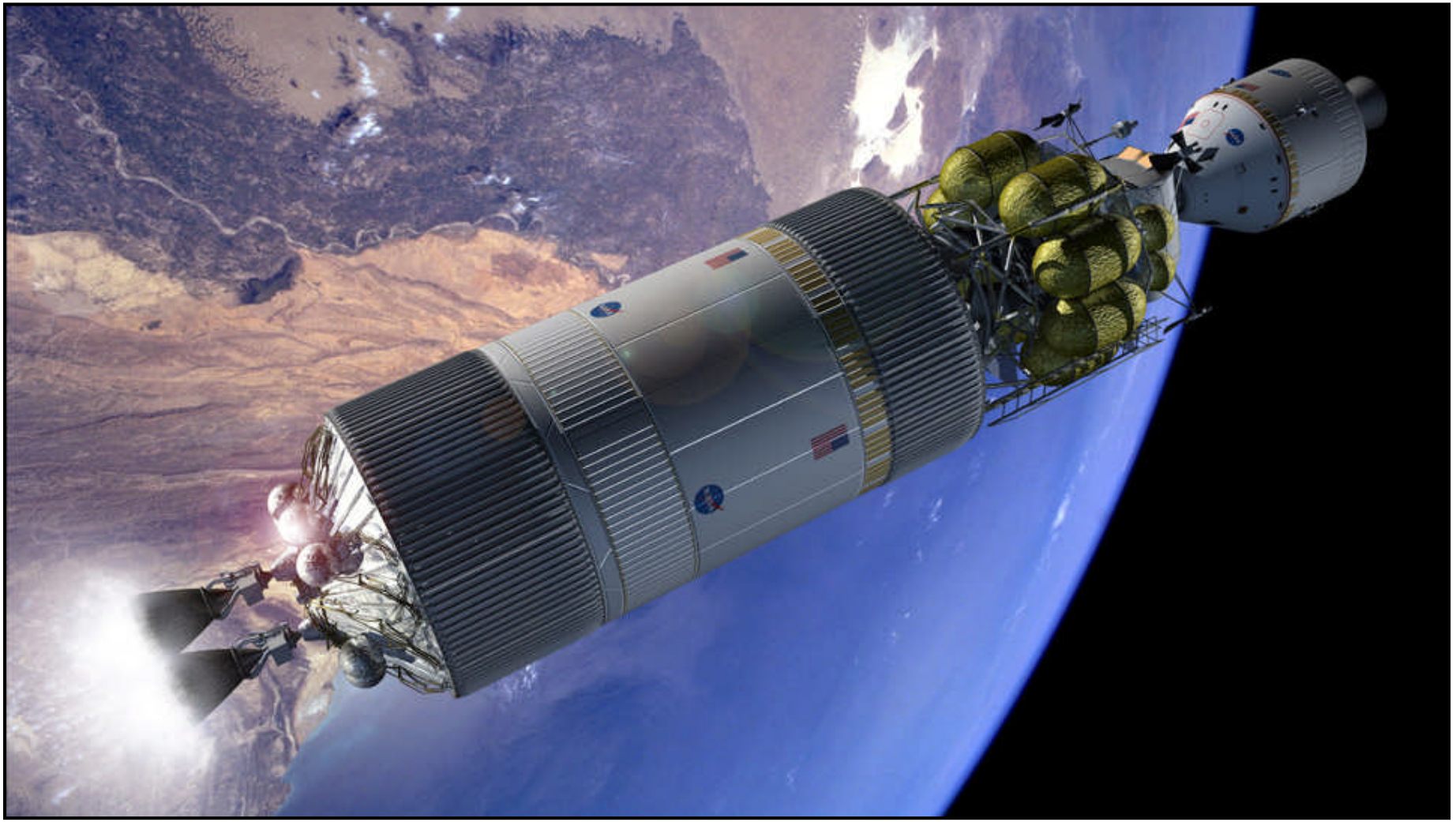
Crew Exploration Vehicle (CEV) on Crew Launch Vehicle (CLV)



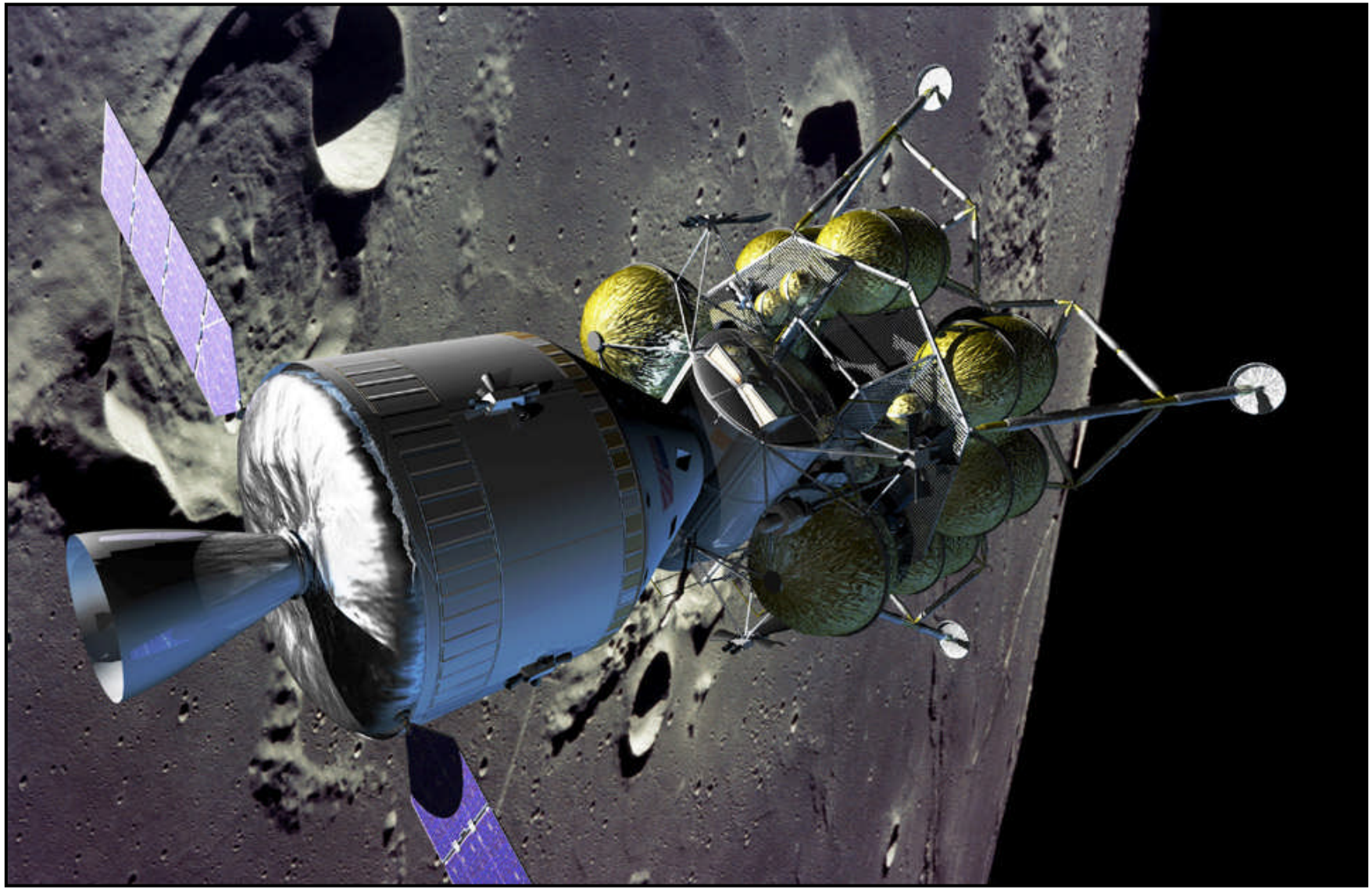
Lunar Surface Access Module (LSAM) on Cargo Launch Vehicle (CaLV)



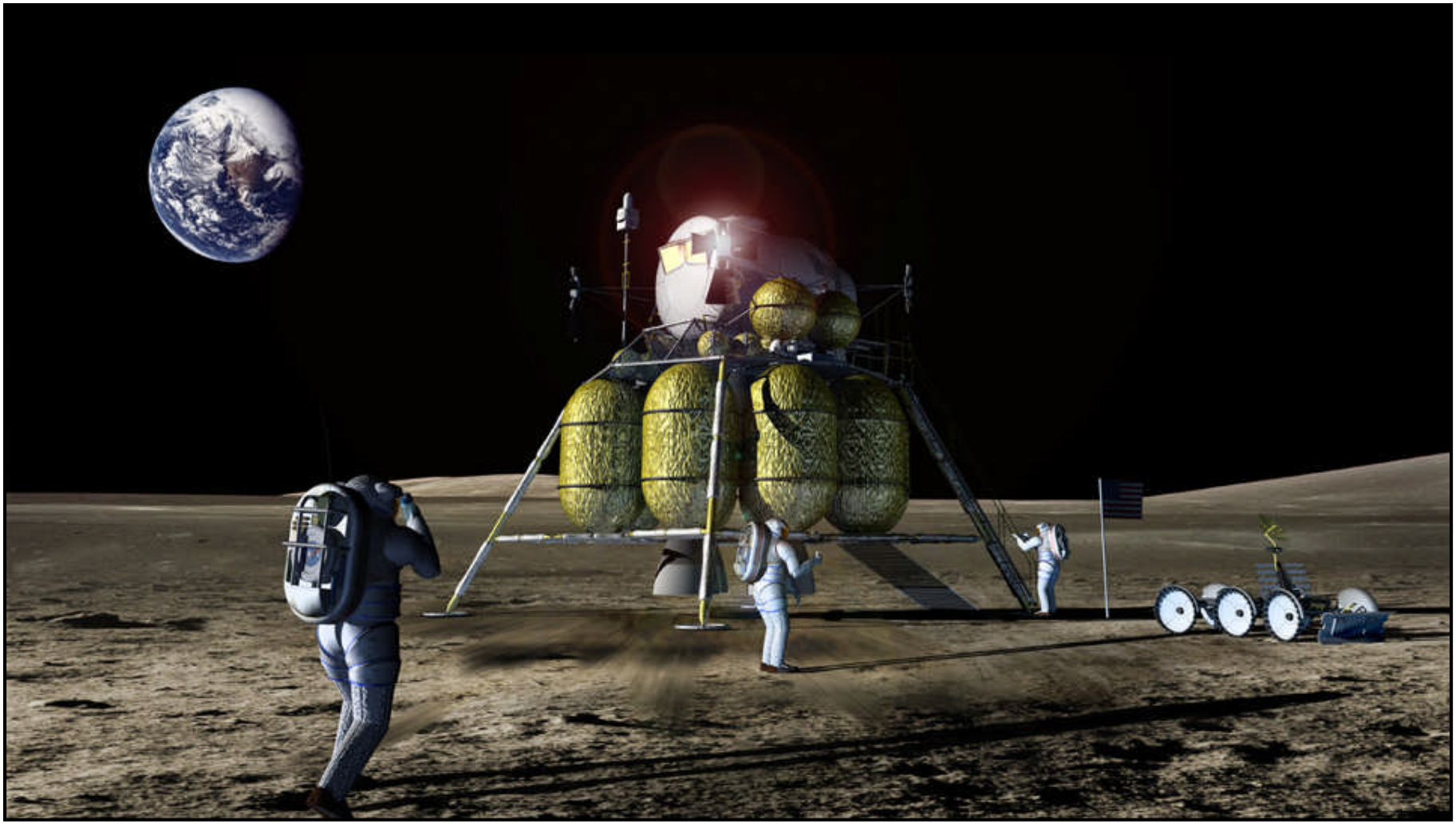
CEV and LSAM
on Earth Departure Stage (EDS)



CEV and LSAM at the Moon



LSAM on the Moon

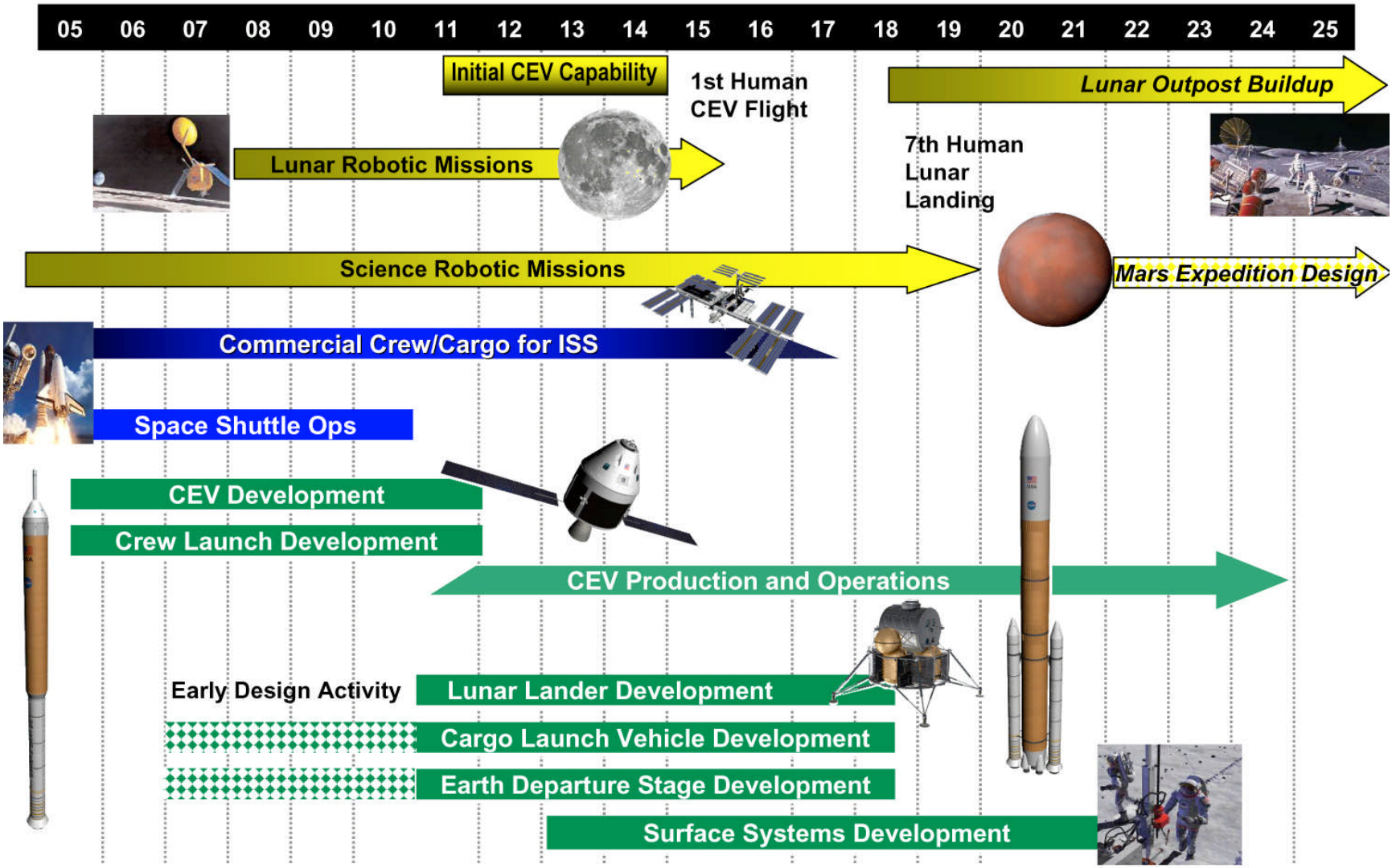


Launch of Ascent Stage

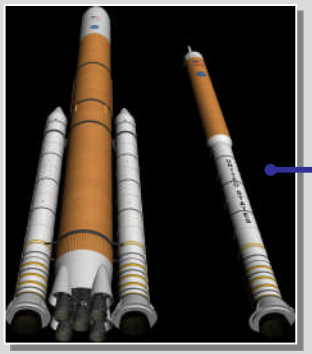
Crew Module Parachuting to Earth

Crew Module with Landing Attenuation System Deployed

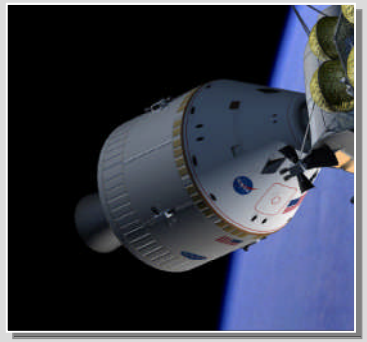
NASA's Exploration Roadmap



Major Constellation Assignments



- Space Suits (JSC)
- Launch Vehicles (MSFC) (CLV-CaLV-EDS)
- Lunar Surface Access Module (MSFC)
- Lunar Ascent (TBD)
- CEV (JSC)
- CEV Support Module (GRC)



Outline

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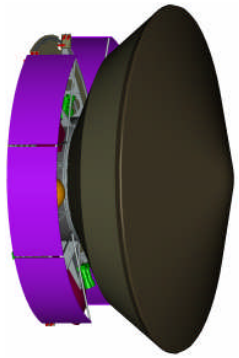
On To Mars

- **Challenges**
  - Mars atmosphere
    - Too thin to help much…too thick to ignore
  - Long ride there and the long ride back
  - A long term program in a nation with a short term planning horizon culture
  - skills

On to Mars-How It Might Be Done

- 6 launches of the Cargo Vehicle place 6 100 + metric ton payloads in low Earth orbit
- Payloads are assembled into a Mars Expedition Vehicle
- 12 month trip to Mars
- Expedition enters into an orbit around Mars
- Lander descends to a “camp” pre positioned with equipment including system to utilize local resources
  - Water ice
- 600 day stay on Mars
- Return to low Mars orbit, rendezvous with orbiting assets
- 12 month return to Earth
- 2030? 2040?

Mars 2009 Mission Overview

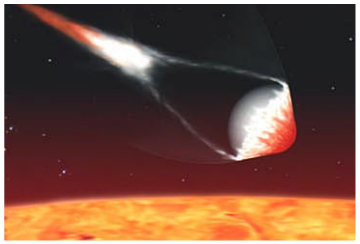


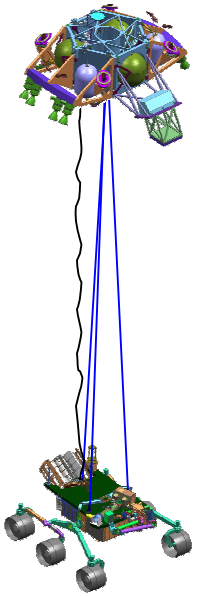
CRUISE/APPROACH

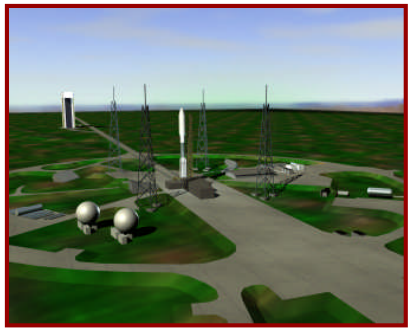
- 10-12 month flight time
- Jettisoned Cruise Stage

ENTRY/ DESCENT/ LANDING

- Direct Guided Entry
- Precision Landing ≤10 km radius
- Altitudes ≤ 2 km
- Skycrane Rover Deployment





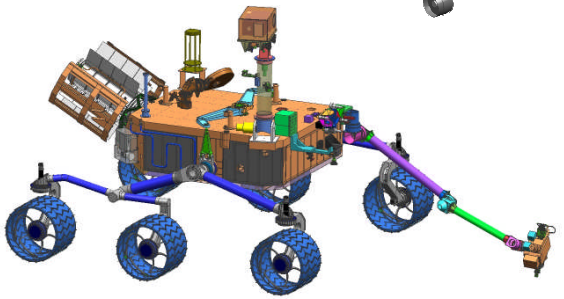


LAUNCH

- September 2009
- Atlas V/Delta IV
- 5-m fairing

SURFACE MISSION

- 775 kg rover
- 10 instruments (75 kg)
- One Mars year mission
- ± 60° latitude
- Discovery Responsive
- ≥ 20 km mobility
- RTG and Batteries Power Source
- UHF Comm. (X-band B/U)



The Next Generation Rover- Mars 2009